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unusually clear way and is free from unnecessary technicalities; in fact the treatment may be said to be popular in the best sense of the word. This perhaps is the reason the book has been set in Gothic instead of Roman type, a fact which will appeal to the average German reader, though perhaps not to those outside Germany. The material is thoroughly modern without, however, involving the reader in present-day disputed questions, and in some respects the volume may be looked upon as a rewriting of the ground covered by Bergmann and Leuckart's "Anatomisch-physiologisch Uebersicht des Tierreiches." To this work the author acknowledges much indebtedness and appropriately dedicates his volume to its authors. In the revival of interest in the study of form and function Professor Hesse's volume should find its place on the book shelf of every zoologist.

G. H. Parker.

PLANT PHYSIOLOGY[1]

Dr. Kauffman has published a very interesting paper on the influence of various substances on the sexual and other characters of certain species of Saprolegniaceae. Thorough studies of this kind are likely to add much to our knowledge of the biology of the fungi and will eventually, no doubt, furnish a mass of data which may be of material aid in the solution of some of the fundamental problems of evolution and variation.

One notable advance made by the author is the use of pure cultures obtained from single zoospores. A very successful and apparently simple method of obtaining the single spore cultures is described. It consists in making dilutions of zoospores in sterile water and sprinkling them with a pipette on the surface of a gelatine plate where they can be located with the microscope, and when they have germinated, they may be transferred to other plates or tubes.

The author does not state how many generations of each organism were grown from the same original single zoospore culture under the same conditions. We infer from his account, however, that in most cases the transfers were made from portions of the mycelium or gemmæ and were in the nature of vegetative reproductions rather than new generations.

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[1] "A Contribution to the Physiology of the Saprolegniaceæ, with Special Reference to the Variation of the Sexual Organs," C. H. Kauffman (*Annals of Botany,* No. 87, Vol. 22, p. 361, July, 1908).

We doubt whether some of the conclusions reached, in regard to the causal nature of the various chemicals used in the different cultures in producing oogonia and other changes in certain of the species studied, should be accepted without further study and more conclusive evidence. The author says: "The results so far indicated show that it is possible to produce, where hitherto they were believed to be absent, antheridial branches of the normal type known in other species of the family, and that their production is conditioned by the presence of definite inorganic salts." The fact that antheridial branches appeared quite constantly in cultures containing certain inorganic salts, does not, in our opinion, necessarily prove that their occurrence was due entirely to the action of such salts. In order to make such a conclusion justifiable, it would be necessary, at least, to carry on a very long series of cultures, covering many generations of pedigreed forms originating from different individuals of the organism under investigation, to say nothing of other possible factors which may be unknown. It seems probable from recent investigations by Miss Wakefield[2] and others that there are fertile and sterile races or strains of species which differ in no other respect from each other and apparently do not depend upon the presence of any particular inorganic salt. An organism reproduced vegetatively would also presumably tend to be more constant in its behavior and show less variation than when each new generation was produced from spores.

Our studies of pedigreed strains of many generations of *Glœosporium* and *Colletotrichum* started from single spores lead us to the conclusion that there are some other factors or forces involved in the variations which occur in different generations from single spores which have no perceivable connection, so far as yet determined, with the composition of the medium in which they grow. Apparently spontaneous variations appear in such series of generations at the most unexpected moment under apparently identical conditions of environment and culture media. We say apparently because it is probably beyond our power at present to determine much less to control all the factors concerned in the growth and behavior of an organism.

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[2] Wakefield, E. M., "Die Bedingungen der Fruchtkorperbildung bei Hymenomyceten, sowie das Aufftreten fertiler und steriler Stamme bei denselben," *Naturwis. Zeitschrift fur Forst- und Landwirtschaft,* 7. Jahrgang, 1909, 11 Heft, pp. 521–551, 1909.

Some series of cultures which produce no oogonia are believed by the author to possess a distinct physiological character in this respect, whereby they can be readily separated from series which produce oogonia. If these organisms obey the same general laws as those with which we have been working, it would be injudicious, at least, to say positively that they do not produce oogonia without having grown them for many generations and from different individuals of the same origin.

The idea, that the same conditions of nutrition, temperature and general environment always produce the same results upon the individuals of a species of organism, has, we believe, as yet no sufficient basis in demonstrated fact. The suggestion of the author, that a standard for the measurement of species comparable to the standards used in physics and chemistry, can be devised, is, we fear, a delusion and indicates a failure to recognize the apparently fundamental fact of biology that organisms possess inherent tendencies or forces which may enable them to vary without necessary dependence on any particular nutritive substance or environmental condition which can be at present definitely determined. The causes of these variations or mutations may perhaps be determined when we are able to recognize, analyze, measure and control all the numerous delicate complex factors concerned, many of which are now probably beyond us and not even surmised.

At another point essentially the same solution of the ever-vexing and recurring species question is given as follows: "At first thought this seems to indicate that no separation can be made of the different species of Saprolegniaceæ by means of constant characters. We can, however, use the resources of the chemist and physicist, and, by stating the exact conditions of culture establish a standard to which all forms may be referred." It is further stated: "It would seem necessary, then, in monographing such a family as the Saprolegniaceæ to refer all the species to definite conditions, which should be uniform for all, and to determine in each case the variability to the extreme attainable limits." If it were practicable to apply such a test, there is apparently little to justify the expectation that it would prove satisfactory. That mutations or variations may be induced or brought into expression by changes in conditions or other stimuli, is probably true, but to determine among the multiplicity and obscurity of the factors in any particular case, just what these conditions or stimuli are, is exceedingly difficult, even though we assume in the beginning that the organism under investigation has no latent hereditary possibilities of change indirectly or not at all dependent upon its immediate environment.

Our work with *Glœosporium* and *Colletotrichum,* part of which is yet unpublished, indicates that so far as these organisms are concerned, at least, no such method would prove practicable; as the same organism, so far as any morphological characters or host relations serve to identify it, will frequently behave very differently when cultures of the organism obtained from different acervuli on leaves of the same host are made. This fact might be easily explained, perhaps, by the assertion that such forms are the elementary species of DeVries and others, or races or strains, but this rather complicates than simplifies the problem. If there are numerous elementary species of the same fungus to be found on the same host without recognizable morphological differences, it is certainly questionable whether any practical taxonomic work could be founded upon such a basis. Until it can be demonstrated that an organism is entirely controlled by its external environment and nutritive conditions and all its hereditary expressed and latent characters are known, it will be hazardous to base positive conclusions upon such data. We must continually keep in mind and be prepared to make allowance for the inherent hereditary characteristics and possibilities of the organism which may possibly find expression in any particular individual or generation.

The vast and complex problems of determining the origin and cause of the form and behavior of even the simplest living organism is not perhaps to be so easily solved. The more it is studied the more difficult it appears. All exact knowledge and data in regard to these phenomena are to be welcomed, however, and the more we come to appreciate the difficulties of the subject the better able we should be to devise experiments that will yield the necessary data which may eventually reveal to our finite minds some of these profound mysteries of nature.

C. L. Shear.